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THE NEW INTERNATIONAL CATALOGUE.

The International Catalogue of Scientific Literature.

M. Botany, part i. (Published for the International Council by the Royal Society of London, 1902.)

WHEN the idea of a complete index of scientific literature was first seriously put forward, it was thought by not a few persons that the magnitude of the task would prove of so overwhelming a nature that its promoters seemed to be courting almost certain failure.

The older "Catalogue of Scientific Papers" published by the Royal Society, although of considerable value, cannot in any sense be called a complete record of the hordes of papers which were pouring forth in ever-increasing volume from the pens of useful and useless writers alike. Moreover, the publication of this catalogue has been in abeyance since 1883.

It is obvious to anyone reflecting on the matter that it was no longer possible for any single scientific society, unless extraordinary funds were placed at its disposal, adequately to continue the work. For apart from the cost of actual production, the catalogue itself, unless rapidly brought up to date by the publication of complete bibliographies at short intervals, must inevitably lose much of its value to those actively engaged in work. And thus on grounds of convenience and utility, as well as of policy, it was decided that endeavours should be made to place the undertaking on an international basis. A considerable number of leading foreign societies and individuals were approached with the view of ascertaining the possibility of evolving a satisfactory scheme which should at the same time be a practicable one. On the whole the replies were so favourable that it became a plain duty to push forward an enterprise from which, if successful, would accrue results of inestimable value to science and hence of immense importance to the world at large.

A conference was held in London during the summer of 1896, and it was attended by representatives of more than twenty different countries. At that meeting the preliminary steps were taken towards the inauguration of a catalogue of which the volume before us comes as the first instalment. A committee of the Royal Society appointed to investigate the working details of the scheme reported to a second representative conference in the autumn of 1898, and at this meeting the general lines on which the work was to proceed were drawn up. A subsequent international conference was held in 1900 to consider the more detailed schemes which had been drafted as the coordinated results of very extensive inquiries and investigations by the Royal Society. Furthermore, inasmuch as in a costly undertaking of this nature financial as well as other kinds of cooperation forms an essential factor of success, this aspect of the matter also received the full consideration of the delegates, and a satisfactory conclusion was arrived at.

As a result of the deliberations, the Royal Society agreed to act as the publishers of the catalogue and to advance the initial capital required, on the understanding that the latter be repaid during the ensuing five

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years. The ultimate control of the whole undertaking is vested in an international council, a convention of which is to be held in London in 1905 and thenceforth at ten-yearly intervals. It has been also agreed, and very wisely, that the scheme of the catalogue as now finally approved is to be given a fair trial of at least five years' duration before any serious modification may be introduced.

The first convention was held in December 1900, when it was resolved that the work should begin forthwith and that the contents of the catalogue should be compiled as from January 1, 1901. It is, however, satisfactory to know that the gap existing between the catalogue of 1800-1883 and that of 1901 now incepted is about to be filled up, and that a list of papers published during this interval, together with a subject-index for the whole period, is in actual course of preparation.

Much of what has here been said will doubtless be already familiar to many readers of NATURE. But only those who have watched the untiring activity of the leaders of this enterprise who have thereby succeeded in doing so much for the organisation of science, can at all adequately estimate the continuous strain and effort required to cause it to take a tangible shape.

As at present determined, the main branches of science are treated separately and are arranged under seventeen heads, each being indicated by a letter of the alphabet. The further ramifications of each branch are grouped according to authors and subjects. The classification of the latter (printed in English, French, German and Italian) is based on convenient subdivisions of the particular science concerned, and the respective headings are denoted, for purposes of index and cross-reference, by numbers. The final units are also arranged in alphabetical order.

The first volume of the catalogue which has just made its appearance deals with the literature of botany, and it is stated to be a first instalment of the entire volume due for the year 1901, and it is promised that a second part shall be forthcoming in the near future. As soon as the difficulties inseparable from the commencement of such a work have been overcome, it is intended that an entire volume shall be published in each year. We venture to think that it might have been well to have waited in the present instance until the volume could have been completed, or else that part i. should have been confined to the literature of a stated portion of the year.

The appearance on the title-page of Mr. Daydon Jackson's name is of itself a guarantee as to the care with which the compilation has been effected. The slips actually detected are few, but we confess that we have not been able to ascertain on what principle some of the omissions are to be accounted for. Thus, to take the case of the *Annals of Botany*, there appeared in the June and September issues two papers, both by M. C. Ferguson, dealing with the reproduction processes in pines, and yet, so far as we can discover, only the second one is quoted. We have also noted other omissions from the *Annals*, to confine ourselves to the case of one periodical alone.

Nevertheless, making due allowance for anomalies which experience will soon correct, the volume deserves

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the highest praise, for it possesses in a large degree just those qualities that one specially seeks in a work of this nature—qualities that will render it an indispensable addition to the library of every serious student of botany. Papers that have appeared in comparatively inaccessible or little-known periodicals are duly recorded in their places, whilst owing to the clearness of the main subdivisions and the excellence of the system of cross-reference, it is usually easy to search out all the literature cognate to any given subject.

The translation of titles originally printed in unfamiliar languages is a useful feature that this volume will share with those dealing with other branches of science.

Another character of special utility lies in the enumeration, under their appropriate subject-headings, of the new genera and species that have been published during the period covered by the volume. It is sincerely to be hoped that it will always be found practicable to continue to give such *complete* lists, although their preparation must necessarily involve no small amount of labour.

It remains to be said that the typographical arrangements are clear and good, and the few printer's errors on which we have lighted are so trifling as to be almost negligible. Those who have been concerned in its production are to be congratulated on the appearance of this, the first instalment of a great work the value and importance of which it would be impossible to overrate.

J. B. FARMER.

THE GEOMETRY OF COG-WHEELS.

La Costruzione degli Ingranaggi. By Prof. D. Tessari. Pp. xvi + 226; with eight lithographed plates. (Turin: Fratelli Bocca, 1902.)

THE study of the proper forms to assign to the teeth of cog-wheels in order that they may run smoothly affords such simple and useful illustrations of the principles of geometry of roulettes that it seems a pity that few mathematical students have time to interest themselves in the matter. In regard to the assertion of certain empiricists that even if the teeth are not constructed on mathematical principles they will adjust themselves in the course of wear, it is pointed out that an immense amount of power will be wasted in wearing the wheels down, and instead of the teeth becoming adjusted they will run loose.

Whatever form be assigned to the profile of the teeth of one wheel, it is possible to construct a suitable profile for the teeth of the second wheel, and the two profiles are said to be *conjugate*. The condition that two profiles may be conjugate is that they must both be roulettes traced by the same rolling curve on the so-called "primitive" circles of the two wheels. If, however, a number of wheels are to be mutually interchangeable, the profiles of any two must be conjugate, and it is necessary that the generating rolling curve or "epicycle" should be the same for every wheel, and the most convenient form is the so-called epi-hypocycloidal form, in which the portion of the profile outside the primitive circle is an epicycloid and that inside the primitive circle a hypocycloid.

An inferior limit to the number of teeth is determined by the condition that contact between one pair must not cease until contact has taken place between the succeeding

pair, and for smooth running it is further desirable for at least two pairs of teeth to be simultaneously in contact. To make the number of teeth a minimum, it is necessary to make the generating "epicycle" as large as possible, in which case the hypocycloidal form becomes a straight line; and it is shown by a diagram that the minimum number of teeth possible is nine for a pair of equal wheels, or six for a rack and pinion arrangement.

Now if the teeth are cut radially down to the base, the narrowness of the base is a source of weakness, especially when the number of teeth is small and their height consequently considerable; moreover, wheels of different sizes constructed in this way are not interchangeable. For such reasons as these another form is frequently adopted in which the profile is an involute of a circle, which is in this case of smaller radius than the primitive circle and is called the "base circle."

We are next introduced to another form of gearing, in which the teeth of one wheel are replaced by circular cylindrical spindles, an arrangement which, by the way, was some years ago tried in the gearing of tricycles for the purpose of reducing friction, and is still illustrated by chain wheels. In this case the conjugate profile is a curve parallel to an epicycloid, or in the case of interior cogs, a parallel to a hypocycloid. A particular case is that in which the ratio of angular velocities is as 1 to 2, when the spindles on the smaller wheel may be reduced to three or even two in number, and these work in rectilinear slots, an arrangement familiar in connection with the so-called "oval chuck" and the "trammel" methods for describing ellipses.

Hitherto the teeth considered have been of cylindrical form, with axes parallel to those of the wheels. We are now led to consider wheels with spiral teeth, an arrangement due originally to Hooke and White, and which is well illustrated by the diagonal rack and pinion coarse adjustment of the modern microscope. This arrangement has been supposed by some writers to eliminate nearly or quite all friction. Prof. Tessari, however, considers that this view is due to an erroneous opinion as to the nature of the contact existing between the surfaces, and, moreover, that further investigation from an experimental standpoint is desirable on the subject of whether any saving of friction is effected by helicoidal cogs as against cylindrical ones. Here is an important subject for researches which might well be carried out in a modern laboratory of experimental mechanics.

In the eighth chapter a new subject is introduced, namely, gears for converting uniform into variable angular velocity, and the first point is the determination of the primitive lines of wheels adapted for the required purpose. In other words, we have to find the form of two perfectly rough curves which by rolling on each other about parallel axes will effect the required transformation. If we assume that the angular coordinates of the two wheels are θ and θ' , and h is the distance apart of the axes, the polar equations of the primitive lines for any given relation between θ and θ' are determined from the equations $r + r' = h$ and $r d\theta = r' d\theta'$. Among the possible arrangements we note a pair of ellipses rotating about their foci, and combinations of elliptic, parabolic or hyperbolic arcs, also arcs of equiangular spirals; many of these arrangements are illustrated by elegant